

THE RELATION BETWEEN CLIMATE AND HEALTH,
WITH SPECIAL REFERENCE TO AMERICAN
OCCUPATION OF THE PHILIPPINE
ISLANDS.¹

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THE purpose of this paper is to discuss the relation between climatic conditions and health, with special reference to Americans in the Philippine Islands. The subject involves a study of climatological reports, medical literature, and statistics. Climatic laws, especially those relating to the tropics, will first be briefly reviewed.

The Director of the Philippine Weather Bureau, Rev. José Algué, clearly expresses the meaning of the term climate in the following definition: "The climate of a country is the complex of the average atmospheric conditions which have an influence upon organic life; therefore, an adequate study of the different elements which go to make up these atmospheric conditions would give a true idea of the climate. The more important elements which form the climate may be reduced to three—viz., heat or temperature; water vapor in its different forms, such as humidity, evaporation, clouds, and precipitation; and finally, the movement or circulation of the atmosphere, which includes the direction and force of the wind, cyclonic and non-cyclonic storms, together with local and general storms."

While temperature is the fundamental phenomenon of climate, several different elements form the basis of its classification, and each classification is affected or modified by other elements or influences. For example, on the basis of temperature we have hot, mild, temperate, and cold climates; on the basis of the influence of continents and oceans, climates are classified as oceanic, insular, and continental; on the basis of salubrity, as healthful and unhealthful.

On account of the spheroidal shape of the earth, temperature varies generally with latitude, but other elements, such as elevation, the presence or absence of vegetation or of large bodies of water, movements of the atmosphere, water vapor in the atmosphere, marine currents, and configuration of land, bring about sharp contrasts in the same latitude, and have a marked influence on animal or vegetable life, or both.

About five degrees each side of the equator is a zone of calms and almost daily thunder showers; beyond this to twenty degrees, a zone of periodical rains in summer, in which zone lie the Philippine

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Islands, characterized by a wet and a dry season; from twenty to twenty-eight degrees, a subtropical zone, in which are the deserts of Sahara, Arabia, and of Northern India, and the arid region of Mexico and Lower California; from twenty-eight to forty-five degrees, a belt of semi-periodical rains, characterized by four seasons and prevailing sunny days (the United States lies principally in this belt).

With respect to elevation above the sea level, there is an average variation of about one degree of temperature for every 300 feet, which is well illustrated by the difference in temperature between Manila and Baguio, Benguet province.

Forests and other vegetations and large bodies of water tend to counteract the effects of terrestrial radiation, and thereby to equalize local climates. On the other hand, a region barren of trees and other vegetation permits wide daily fluctuations of temperature, the days being hot and the nights cold, which become extreme in barren places and arid regions, rising to a mean summer temperature of 95° in Arabia, Persia, and Punjab, India; in the Punjab 125° in the shade has been observed. In a country covered by forests and other vegetation, and in proximity with large bodies of water, the total heat of the day is quite equally distributed over the twenty-four hours, the heat of the day not being excessive, even in the tropics, as illustrated by climatic conditions in the Philippines.

Temperature is greatly modified by movements of the air or winds, which constitute an important climatic influence by increasing evaporation, thus rendering the soil drier, removing dampness, and affecting the "sensible temperature," that is, the apparent temperature which we feel or the physiological temperature. In the tropics, practically covered by the longitudinal extent of the Philippine Islands and from six to twenty degrees north latitude, is a zone of trade winds called monsoons in the Indian Ocean and adjacent portions of the Pacific. Cyclonic movements of the atmosphere, characterized by regularity of course, are called hurricanes in the West Indies and the Indian Ocean, cyclones in the Gulf of Bengal, typhoons in the China Sea, and baguios in the Philippine Islands. The central and northern portions of the Philippine Archipelago lie in the path of these baguios or cyclones, but these regions are free from the cold, raw winds frequently experienced in New England and Canada, in connection with the course of cyclones in that region. Due to similar cyclonic atmospheric movements, the entire Mediterranean region is subject to violent changes of temperature in winter. The central portions of the United States, considerably distant from the sea, are also subject to violent atmospheric changes, where a day that dawns with the ethereal mildness of spring may end in the freezing coldness of winter.

The water vapor of the atmosphere constitutes an important climatic element. The atmosphere contains a variable quantity of

moisture, resulting from vaporization of water through the action of heat rendering it lighter than air. The higher the temperature of the air the more water vapor it can carry, and when increased to the point of saturation, if the temperature is lowered, condensation occurs and results in precipitation in the form of rain or dew, clouds or fog. A rise of temperature, therefore, renders the air drier, and a lowering of temperature, more moist. The greatest amount of evaporation being in equatorial regions produces the equatorial and polar atmospheric currents, which have an important climatic influence on contiguous land bodies. The average quantity of annual rainfall reaches the maximum in the tropics, while the *number* of cloudy or rainy days gradually increases from the equatorial regions toward higher latitudes, and decreases from the coasts to the interior of continents.

The heated waters of the tropics, flowing away from the equatorial regions, are replaced by the colder waters of the polar currents. Moreover, the cold produced by radiation over the surface of the ocean and land adjoining lowers the temperature of the water, which sinks to greater depths, so that, even in the tropics, deep sea observations show the water below the surface to be increasingly cold toward the depths of the sea, where it approaches the freezing point. Local interisland currents, as the Straits of San Bernardino and Surigao, materially modify the temperature of neighboring regions. The following are examples of the influence of marine currents: Washington, D. C., with cold winters and hot summers, is in the same latitude as San Francisco, whose mild winters and comparatively cold summers are due to the influence of the Japan current modified by its sweep across the Northern Pacific. On one side of the Atlantic Ocean is Labrador, treeless and cheerless; on the other side, in about the same latitude, are the British Isles, with abundant vegetation and a comparatively mild climate, which is due to the influence of the northern branch of the Gulf stream. Labrador is subjected to the influence of the cold Labrador or polar current.

In the classification of climates, based on the size and extent of masses of land, oceanic, insular, and continental, the climate of the Philippine Islands is largely that of the first two classes, oceanic and insular. Nowhere is the land distant from the seacoast more than sixty miles. The moderating influences of the great bodies of sea water are therefore operative. On account of climatic influences, the climate of the Philippines is widely different from those of tropical Africa, South America, and Asia in the same latitude. As a rule, the smaller the island the more equable the climate throughout the day and the year. The climate of the greater part of the Philippine Archipelago is for this reason comfortable and hygienically favorable for the treatment of many diseases. In the temperate zone an insular, mild, or equable climate is frequently a health resort.

Observations of the Manila Observatory show that while the temperature as indicated by the thermometer at *sea level* is practically the same throughout the Philippine Archipelago it is higher in some regions than in others during the months of April, May, and June, which cover the period of greatest heat.

During this season there is a mean temperature of about 87° in the northern part of the island of Panay and throughout the Island of Luzon, except the highlands and a portion of the provinces of Pampanga, Bulacan, Rizal, and Bataan.

During this period there is a mean temperature of about 83° in the parts of Luzon excepted above, including Manila and the islands of Romblon and Cebu, the peninsula of Zamboanga, and the west coasts of Samar, Negros, Panay, and Bohol.

A comparatively mild mean temperature of about 80° prevails during this period over the Sulu Archipelago, the extreme southeast of Luzon, and the eastern portions of those islands south of Luzon and contiguous to the Pacific Ocean—viz., Samar, Leyte, and Mindanao. If the readings of the thermometer for the elevated regions were included, these averages would be very considerably reduced.

Except for the months of April, May, and June, in the first and second regions named above, the mean temperature for the remaining part of the year at or near the sea level is about 80° . The observations of the Manila Weather Bureau further show that the annual variation of temperature is greater in the northern than in the southern part of the archipelago.

Some portions of the Philippine Islands are characterized by a rainy season and a dry season, the rainy season gradually beginning in June, being excessive usually in July, August, and September, and gradually decreasing to November; while in other parts of the archipelago there is a more even distribution of rain. Parts of the eastern coast of Northern Luzon and the interior of Luzon above 4000 feet, the Pacific Ocean side of the archipelago, including the eastern portions of the islands of Masbate, Panay, and Bohol, are subject to the heaviest rainfall, amounting to over 100 inches annually. In the other parts of the archipelago, including Manila, the mean annual rainfall is less than 100 inches, decreasing to about 35 inches at Zamboanga.

The geological formation of the Philippine Islands is of volcanic origin, and in places of moderate elevation the earth covered by cultivatable soil is not unhealthful.

The observations of the Manila Weather Bureau show a considerable difference in climate between the coastal regions of the islands of the archipelago and the elevated regions of the islands of Luzon and Mindanao. Mountain climate in these two islands is similar to that of Baguio, Luzon, whose altitude is 4777 feet and whose average temperature and humidity are relatively low during the hot months of March, April, May, and June, owing to the prevailing winds blowing from the China Sea during that season. The

climate of this region is ideal from November to June. The region consists of a rolling table-land well watered. The forests are of pine, and the soil productive. The vegetation is similar to that of the temperate zones. The following table is made up from observations at Baguio covering a period of two or three years:

Month.	Temperature (Fahrenheit).			Humidity (per cent.)	Rainfall (inches).	Rainy days.
	Mean.	Maximum.	Minimum.			
January	63.14	75.38	49.28	78.1	0.92	4
February	60.98	73.94	45.68	77.3	0.21	1
March	65.66	78.44	51.08	76.3	1.09	3
April	68.00	80.24	51.80	75.5	1.66	6
May	67.46	78.80	52.52	83.9	9.42	18
June	66.33	77.72	58.10	89.4	15.92	26
July	65.84	79.70	56.30	89.4	15.33	28
August	65.12	75.74	54.68	92.2	42.89	31
September	65.66	74.48	57.20	90.5	17.81	26
October	65.56	75.92	55.40	83.7	6.65	14
November	65.84	75.56	52.16	79.0	2.75	10
December	64.94	75.02	54.68	81.2	3.19	10
Year	65.48	76.82	53.24	83.0	117.84	177

With a mean annual temperature of 80°, an annual average humidity of about 79 per cent., and an average annual rainfall of about seventy-six inches, Manila occupies an intermediate position in the archipelago, climatically as well as geographically. The average annual rainfall is less than that of Baguio (118.04), Albay (110.90), Negros (102.02), Singapore (93.22), Bombay (92.72), and Hongkong (86.85), and more than that of Batavia (71.15), San Isidro (70.71), Iloilo (69.85), Calcutta (60.83), New Orleans (60.30), Porto Rico (59.45), Jolo (59.28), Tokyo (57.78), Havana (51.74), Cebu (47.18), New York (44.70), Shanghai (44.06), Washington, D. C. (42.90), Honolulu (39.22), Key West (38.20), Zamboanga (34.89), Chicago (34.00), and San Francisco (23.40).

In Manila the average amount of sunshine, measured by hours, and its distribution corresponds closely with the average clear and partly cloudy days for each month and for the year, as shown in the following table:

Month.	Average clear and partly cloudy days.
January	23.9
February	23.8
March	23.9
April	25.1
May	19.9
June	17.3
July	14.9
August	14.0
September	13.1
October	17.1
November	18.6
December	22.6
Total	234.2
Average	19.5

From this table it is seen that the minimum of clear and partly cloudy days in Manila occurs in September, and the maximum in April.

The climate of Manila is quite fully demonstrated in the following table, made up from observations of the Manila Weather Bureau covering a period of over twenty years, giving the mean monthly and annual temperature, the mean daily, monthly, and annual ranges of temperature, the normal average of the humidity, the normal amount of rainfall, and the average number of days of rainfall:

Month.	Temperature (Fahrenheit).					Mean humid- ity. ¹	Mean rain- fall. ²	Mean rainy days.
	Mean	Mean monthly max.	Mean monthly min.	Mean daily range.	Mean monthly range.			
January . . .	77.18	89.78	64.22	13.68	25.56	77.6	1.14	5
February . . .	78.08	91.22	64.40	15.30	26.82	74.2	0.39	3
March . . .	80.42	93.74	65.30	15.48	28.44	71.8	0.73	3
April . . .	83.12	95.90	69.44	16.02	26.46	70.7	1.12	4
May . . .	83.84	96.98	72.86	12.60	24.12	76.7	4.00	9
June . . .	82.40	95.00	72.68	10.80	22.32	81.4	9.75	16
July . . .	80.96	92.30	72.32	9.00	19.98	84.8	15.00	21
August . . .	80.96	91.40	72.14	8.64	19.26	84.8	14.22	21
September . . .	80.78	91.94	72.32	8.28	19.62	85.5	14.75	20
October . . .	80.60	91.94	70.52	10.08	21.42	82.7	7.55	16
November . . .	79.16	89.96	68.54	10.26	21.42	82.0	5.37	12
December . . .	77.36	89.78	64.94	11.16	24.84	80.7	2.29	8
Year . . .	80.42	92.48	69.08	11.70	23.40	79.4	76.31	138

¹ From observations covering the period 1883-1902.

² " " " " " " 1865-1902.

The normal monthly average relative humidity in Manila ranges from 70 to 85 per cent., with a normal average of less than 80 per cent., is lowest during the hot, dry season, when high temperature prevails, and highest during the rainy season, when more moderate temperature prevails. The quantity of water vapor in the atmosphere thus affects the diurnal and yearly ranges of temperature, and particularly the "sensible" temperature. Air saturated with moisture feels hotter than the thermometer actually indicates, and if near the body temperature the cooling process by evaporation is completely checked.

Besides the amount of humidity in the atmosphere, "sensible" temperature depends upon many other factors, important in the Philippine Islands, not entering into temperature as recorded by the thermometer—viz., movements of air, exposure to direct rays of the sun, reflected heat, one's physical and mental condition, clothing, occupation, food, etc., variations in which tend to produce comfort or discomfort. These factors are given detailed consideration in another part of this paper.

On the following page is given a comparative table between the United States weather districts and Manila, with respect to humidity and precipitation:

Districts.	RELATIVE HUMIDITY.					PRECIPITATION.						
	Normal	1903	Departures.			Normal	1903	Departures.				
			1903 from U. S. normal	1903 from Manila normal	U. S. normal from Manila normal			1903 from U. S. normal	1903 from Manila normal	U. S. normal from Manila normal		
New England	77	77	0	2.2	1.6	43.0	88.7	-4.8	1.9	-36.9	-41.0	-32.6
Middle Atlantic	74	74	-1	0.8	4.6	43.8	43.8	0.0	8.2	-81.8	-40.2	-31.8
South Atlantic	77	76	-1	1.2	2.6	52.0	47.6	-4.4	7.0	-28.0	-32.0	-23.6
Florida Peninsula	79	78	1	3.2	0.6	51.0	48.1	-2.9	7.5	-27.5	-33.0	-24.6
East Gulf	75	76	1	1.2	2.6	56.0	49.0	-7.0	8.4	-26.6	-28.0	-19.6
West Gulf	74	74	0	0.8	4.6	46.2	38.2	-8.0	2.4	-37.4	-40.8	-32.4
Ohio Valley and Tennessee	72	73	1	1.8	5.6	45.2	37.4	-7.8	3.2	-38.2	-38.8	-30.4
Lower Lakes	74	76	2	1.2	2.6	35.4	35.3	-0.1	5.3	-40.3	-48.6	-40.2
Upper Lakes	77	76	-1	1.2	2.6	32.2	31.6	-0.6	9.0	-44.0	-51.8	-43.4
North Dakota	72	72	0	2.8	6.6	18.9	21.3	+2.4	19.3	-54.3	-65.1	-56.7
Upper Mississippi Valley	72	74	2	0.8	4.6	16.6	34.3	+3.5	6.8	-41.8	-49.7	-41.3
Missouri Valley	69	72	3	2.8	6.6	28.7	33.8	+0.5	8.4	-43.4	-55.3	-46.9
Northern Slope	61	68	7	6.8	10.6	17.6	22.4	+0.4	18.0	-53.0	-61.8	-53.2
Middle Slope	62	66	4	8.8	12.6	17.5	22.0	+0.2	18.6	-53.6	-61.8	-53.4
Southern Slope	62	64	2	10.8	14.6	16.6	23.4	+0.2	17.2	-52.2	-60.8	-52.4
Southern Plateau	39	39	0	-8.8	-39.6	40.5	39.6	-0.9	31.3	-66.3	-73.8	-65.4
Middle Plateau	50	53	3	-21.8	-25.6	29.5	11.3	-2.8	32.1	-67.1	-72.7	-64.3
Northern Plateau	62	63	1	-11.8	-15.6	16.6	15.6	-2.9	27.9	-62.9	-68.4	-60.0
North Pacific	80	80	0	5.2	1.4	51.9	43.7	-8.2	3.1	-31.9	-32.1	-23.7
Middle Pacific	71	69	-2	5.8	9.6	29.4	24.0	-5.4	16.5	-51.6	-54.6	-46.2
South Pacific	68	68	0	6.8	-10.6	14.5	10.3	-4.2	30.3	-65.3	-69.5	-61.1
Manila	Normal (1)	1903		Manila 1903 from normal	Manila 1904 from normal	Normal (2)	1903		Manila 1903 from normal	Manila 1904 from normal		
	78.6	74.8		-3.8	+0.9	75.6	40.6		-35.0	+8.4		

1 From observations covering the period 1883-1904.

2 From observations covering the period 1865-1904.

The following is a comparative table with respect to temperature, humidity, and precipitation between Manila and five other tropical cities in the Far East:

City.	Latitude.	Temperature.			Relative humidity. Annual normal.	Rainfall.	
		1901. Max. mean.	1901. Min. mean.	Annual normal.		Annual normal.	Rainy days.
Singapore . . .	N. 1° 17'	86.7	74.3	79.90	80.0	93.22	174
Rangoon . . .	N. 16 46	89.3	72.7	79.06	87.0	98.89	116
Calcutta . . .	N. 22 23	86.3	70.7	77.85	82.0	60.83	85
Bombay . . .	N. 18 58	85.5	74.7	79.88	78.0	82.72	76
Batavia . . .	S. 6 8	82.9	73.0	78.80	82.8	71.15	156
Manila . . .	N. 14 35	88.2	72.1	80.40	78.6	75.61	138

As early as 1797 Heberden, and later in 1863 Scoresby-Jackson, conducted investigations in England and Scotland, respectively, on the influence of cold on health, and reached the conclusion that "mean temperature and mortality from all causes had an inverse relationship below 50° F."

From the investigations of Buchan, Mitchell, and Pettenkofer, the following general propositions were deduced:

"1. A preternaturally dry air, with a high temperature, predisposes to the development of fevers and intestinal diseases.

"2. A very moist atmosphere, accompanied by a low temperature, is likely to induce bronchial and rheumatic affections.

"3. In summer and autumn the tendency to sickness and death is chiefly connected with the digestive organs.

"4. In summer and autumn a rise of mean temperature above the average increases the number of cases of and mortality from diseases of the digestive organs.

"5. A cool and rainy summer controls the prevalence and fatality of diarrhoeal diseases."

The effects of temperature in producing disease are often confounded with the change of temperature, the latter of which is, perhaps, the more important of the two.

The literature with reference to the effects of tropical climates upon the human body appears to be even more exhaustive than that applicable to the temperate zone.

It has been shown that the presence or absence of vegetation affects temperature, and that the condition and character of soil have an important relation to health, the influence of which is exerted mainly through the media of water and air.

Twenty years ago Parkes defined the effects of climate upon the human body to be "the sum of the influences which are connected with the solar agencies, the soil, the air, or the water of a place," and stated that: "The deaths in the West Indies were partly owing to the virulence of yellow fever . . . and the general excess of

other febrile and dysenteric causes. The simple precautions which are efficacious in England have been as useful in the West Indies. Proper food, good water, pure air have been supplied, and, in proportion as they have been so, the deadly effects attributed to climate have disappeared. The effect of a tropical climate is, so to speak, relative. . . . Take away these sanitary defects, and avoid malarious soils or drain them, and let the mode of living be a proper one, and the European soldier does not die faster in the tropics than at home."

Billings, writing at that time, and Williams at a later period, expressed substantially the same views.

Some authorities take the view that in certain portions of the tropics and under favorable conditions, acclimation is possible; this group includes Quatrefages, Bertillon, Treille, van der Berg, Overbeck de Meyjer, Schellong, Daübler, and Koch. Daübler says that "Health in the tropics depends upon tropical hygiene and ethnic adaptability or acclimation, the manner of living playing the most important role." Stockvis and Below say without qualification that adaptation of Europeans to conditions in the tropics is possible.

It is admitted that colonization has been successful in Queensland, Australia, lying between the parallels of fifteen and twenty-eight degrees, south latitude, a region partly tropical and partly subtropical, which increased in white population from 28,000 in 1856 to 343,000 in 1886. Queensland has as low a rate of mortality as Europe.

Daübler concluded that European colonization has been successful in certain subtropical and bordering tropical regions. Virchow, Carey, Cosales, and Stanley give statistics in which they state that the European may, under proper sanitary conditions, transplant himself anywhere. Thomas says: "Under the tropical skies the climate is not an obstacle. The soil remains the only enemy we have to conquer." As to whether vital energy is sustained in the tropics, Stockvis says: "Not only is European acclimation in the tropics possible, but also full colonization," his statement being based on "results of exact observations in the laboratory at Batavia, as well as upon statistics of European colonization in South America." Felkin was able to conclude from his observations in Africa that "The adaptation of the white race to a tropical climate is possible," and Calvert concludes that it is practicable.

Nevertheless, the proposition early laid down that it is impossible for the white race to adapt itself to a tropical climate is supported by Lind, Saulnier, Divivier, Boudin, Helfft, Hirsch, and Rower. Munson expresses similar views, but states that "It is not at all easy to say how much of the excess of mortality of Europeans in tropical and subtropical countries over that of the natives is simply attributable to climate *per se*, and is consequently inevitable, or how much of it is the direct consequence of unsuitable habits of life and of the

neglect of sanitary laws and of personal hygiene." Munson's statement to the effect that there is an excess of mortality among Europeans in tropical and subtropical countries over that of the natives does not appear to be borne out with respect to the Philippine Islands by the last published report of the Board of Health, which shows the death rate in Manila for the twelve months prior to September 1, 1903, as follows: Filipinos, 43.42 per cent; Chinese, 28.26 per cent.; foreigners, 18.72 per cent.; Americans, 14.80 per cent. Excluding cholera, the death rate for Americans for the same period was only 3.83 per cent. The comparative death rate of natives in the army seems to corroborate the report of the Board of Health in this matter. While it is true that the native is less susceptible to a few diseases than is the white race, the evidence is cumulative that the rate of mortality among the white race now living in the tropics is less than that of the native population.

Conclusions as to the unhealthfulness of tropical climates appear to have been drawn principally from statistics relating to military organizations, and proper consideration does not appear to have been given to the fact that in many parts of the tropics colonies of representatives of Northern as well as of Southern Europe have lived for years or for generations in comparative health and comfort in India, in the straits settlements, in the East Indies, and in the West Indies. This statement is amply verified in the history of cities of Southern Asia, including Bombay and Calcutta, and of the islands of the East Indies, including Manila.

Referring to the problem of the relations of climate to health, Calvert sagely observes that "Statistics of military operations possess practically no value in an inquiry of this nature, for troops campaigning in any country are most liable to diseases."

The classical proposition that a white man cannot adapt himself to a tropical climate appears to be based partly on the experience gained in former times through exploration and attempts to colonize in the tropics. The results were generally disastrous and have not been forgotten, being constantly referred to as conclusive evidence of the impossibility of colonization by the white race in the torrid zone. Disease and death invariably accompany the invasion of an army into any country, whether it be in the temperate or in the torrid zone. It is likewise true that, while great heat is borne by the system if the body temperature is kept down by abundant perspiration, and if the hot season is not of long duration, protracted residence in a region of *great* or *intense* heat appears to exercise a depressing influence, "lessening the nervous activity and impairing the great functions of digestion and respiration and sanguification and probably the power of forming new and healthy tissue." There are many parts of the tropics, however, where the heat is not intense at any period of the year, or where the season of intense heat is not of long duration, in which the evidence is cumulative that the white

race can live for an extended period without forfeiture of health or longevity. In the tropics there has been a steady decrease in the amount of illness and in the death rate among Europeans in the colonial possessions of the British, Dutch, and French. There has been no material change in the climate either of the temperate zone or of the tropics. As the climate has not materially changed, the reduction many fold in the amount of illness and the mortality rate must be accounted for largely by the observance in the tropics of the hygienic measures of modern times which obtain in the temperate zone.

There has been improvement in health conditions in the United States, just as there has been more recently in the tropics, with improvement in hygienic living and surroundings. A portion of the tropical world will probably continue to be unhealthful for Europeans until there can be observance of the rules of personal, domestic, and public hygiene. Insular and other portions of the tropics, where the temperature, relative humidity, and soil conditions are favorable are not shown to be essentially unhealthful.

For the period prior to 1900 there are "no statistical records of sanitary value" available for comparison of health conditions in the city of Manila or the Philippines. The report of the Commissioner of Public Health for the year ended August 31, 1903, shows a steady improvement in general health conditions. Excluding cholera, which the Commissioner states "is to be regarded as an exotic in the Philippine Islands," the *general* mortality rate decreased from 39.66 per cent. in 1900 to 29.45 per cent. in 1903. The death rate among Americans of 3.83 per cent. for the same period and of 1.82 per cent. for the year ended August 31, 1904, were very much lower than the *general* mortality rates in Manila or most cities in the temperate zones. The American population, however, does not include the usual proportion of old and young persons, and some have returned to the United States on account of illness. From the best information obtainable, the mortality rates of infants and of old people among the whites are not greater than those in the United States, and the death rate of those who returned to the States is very low.

The mortality of infants under one year of age among the natives is shown to have been 40 per cent. of the total number of deaths and to have exceeded "the combined mortality of Asiatic cholera, bubonic plague, smallpox, dysentery, malarial fever, typhoid fever, and beriberi." Attention is called to the fact that the *general* death rate in Ermita district, where reside a larger proportion of whites than in other districts of Manila, was 19.22 per cent., "about the same as that of the best modern cities." The excessive infant mortality among *natives* is due to the lack of proper care and food. The health reports show that of the total number of deaths in the city of Manila, approximately one-half occur "in the absence of any treat-

ment of a qualified physician." The high death rate among the natives appears to be largely independent of climatic influences, and accounts for the islands being so sparsely inhabited. The population of Java (area 51,961 square miles), with similar climatic conditions, increased from about 17,291,000 in 1872 to 24,133,685 in 1891, while the population of the Philippines, with an area of 127,863 square miles, more than double the area of Java, is approximately 7,000,000, an increase since 1887 of only about 1,000,000.

With respect to cholera, smallpox, malaria, and beriberi, the Commissioner of Public Health states:

"The Filipinos have been not only more liable to contract cholera than the Chinese or Americans, but, when they do get the disease, they are almost twice as liable to die therefrom. The number of Americans who contracted the disease is unduly high; but the cases occurred largely among soldiers who entered native houses and partook of native foods and drinks in defiance of standing military orders.

"During the twelve months prior to September 1, 1903, there were 99 cases of smallpox in Manila, with 16 deaths, or no more than occur from this cause in various cities of the United States of equal size having a large dark-skinned population.

"Malarial disease is by no means as common or dangerous in the Philippines as in many other parts of the tropics.

"Whites are relatively very insusceptible to the disease (beriberi) and but few cases occur among them."

Notwithstanding the unfavorable sanitary and hygienic conditions, statistics of the Board of Health show, by comparison of death rates for other cities, that Manila in 1903 was more healthful than were in the preceding year or two Bombay and Calcutta, and compared favorably with Hongkong, Moscow, Trieste, Naples, Madrid, Cairo, Alexandria, New Orleans, Charleston, Memphis, and other cities in the temperate zone.

Referring to the health of the army, the Surgeon-General states: "The sanitary improvements in the conditions of the soldiers have gradually lessened the rates of sickness and mortality since the war, and, although a large proportion of the troops have been on practically war service in the Philippine Islands since 1898, the rates of sickness and mortality for the calendar year 1903 more nearly approach those of 1897, when the low death rate of 5.11 per thousand of strength for the whole army was recorded, than at any time since the outbreak of the Spanish-American war. This is a most gratifying state of affairs, and it is hoped that with the present sanitary knowledge put to practical energetic use a further reduction in the rates of sickness and mortality in the army will be effected."

Commenting on discharges for disability, the report of the Surgeon-General states: "It is true that with the most rigid examination some physically unfit men will be accepted. It is believed, however,

that one-third of the recruits who were afterward discharged for disability during the year 1903 should have been passed physically."

The statistics of the Surgeon-General's reports do not give complete and exact data as to the comparative health conditions between American soldiers in the United States, American soldiers in the Philippines, and native soldiers in the Philippines. From information contained in the reports, however, it is inferred that while the amount of sickness in the islands among American soldiers and native soldiers is about the same, the mortality rate of the natives is higher than that of the Americans, and that at no equal period of time has the mortality rate on account of sickness in the Philippines been as high as it was during the Civil War or during the Spanish-American war.

Asiatic cholera, yellow fever, dysentery, malarial fevers, and their sequelæ, which have occurred extensively in the United States and elsewhere in the temperate zone, as well as in the tropics, are not the destroyers of former times. Yellow fever is not a factor in the health problem of the Philippines, and Asiatic cholera is now non-existent in the islands.

As to malaria in tropical regions, the worst forms exist in Central America and along the banks of rivers and in great river deltas of Africa and South America. It is common in India, Southern China, and in most parts of the East Indies, rare in Japan, Australia, New Caledonia, some of the South Sea Islands, and practically unknown in the Hawaiian Islands, Samoa, and New Zealand. In Manila and the greater portion of the Philippines, where Americans are required to live, malaria does not seriously affect the health of the white man who observes the reasonable hygienic measures which are required to be free from this disease during part or all of the year in many portions of the United States. The difference between the care of troops in modern times and formerly is illustrated by an instance in Ceylon, where in former times it is shown that at a certain station out of a total strength of 254 men all contracted malarial fever and 205 died; whereas the admissions for this disease in Ceylon in 1898 were only 71 per thousand.

Dysentery and other intestinal diseases in the Philippines are becoming less frequent in proportion as there is increased observance of domestic hygiene. The important diseases which are limited to the tropics are few. The great proportion of the decimating diseases have been more or less common in both the tropics and the temperate zones. As increased temperature and humidity, however, favor putrefactive changes and the growth and development of micro-organisms, some diseases are more prevalent in the tropics than elsewhere. On the other hand, sunshine, with little moisture and periodic heavy rainfall, are health-promoting agencies. In the

greater part of the Philippines, as in the greater part of the United States, the question of climate in its relation to health appears to resolve itself principally into the ability of man to circumvent disease through sanitary and hygienic measures.

It has been demonstrated in the Philippines that bubonic plague can be controlled by preventive measures, although it is an extremely fatal disease, as is cholera. Fortunately, however, comparatively few Europeans in the Philippines were attacked by cholera during its recent visitation, and fewer still by bubonic plague, only those suffering from disease whose manner of living is most unsanitary or who fail to observe reasonable hygienic precautions.

Of three great ravaging diseases in the United States—viz., tuberculosis, enteric fever, and pneumonia—tuberculous cases among Americans in the Philippines are less frequent than in the United States, and enteric fever and pneumonia are comparatively rare. In Manila for the year ended August 31, 1904, but two deaths occurred from enteric fever and two from pneumonia among the European or foreign population.

The greatly increased amount of sickness and death from intestinal diseases during the hot season in the United States, and from respiratory diseases on account of the cold, damp, and changeable weather of the winter and spring seasons, together with many diseases which are rare or unknown in the Philippines, but prevalent in the United States, are important considerations when comparing the healthfulness of the climate of the Philippines with that of the United States.

Among the more or less prevalent diseases in the United States which appear to be comparatively rare or unknown in the Philippine Islands are gout, rheumatism, rheumatoid arthritis, neuralgia, cancer, enteric fever, relapsing fever, rubeola, scarlatina, diphtheria, rabies, and nearly all diseases of the respiratory system.

The character of dwellings with respect to structure, arrangement, and sanitary features is important from the standpoint of health and comfort. A house cannot be said to be in a hygienic condition which is so constructed as to prevent the sun's rays from reaching every portion of the interior when desired. An old Italian proverb has it, "Where the sun does not enter, the physician will."

In a tropical climate a house properly constructed and located, with a sufficient space around it to ensure free circulation of air, will have at any time of day or night some portion comparatively cool and comfortable. As the relative humidity of the air is greater near the surface of the earth during the night, when the temperature is at or near the daily minimum, approaching the dew point, dwellings in the tropics should be so constructed that the sleeping rooms are as far above the ground as practicable. A considerable proportion, approximately one-third, of the volume of soil consists of air. It is

a common occurrence in the Philippines to observe a house built on damp soil with the subsoil water near the surface, a depository of organic matter, the inhabitants being subjected to the emanations from the soil, especially at night, through open floors, putrefaction being active in the soil.

While the so-called "miasma" and "effluvia" possess little value as definite etiological factors of disease, the high specific gravity of certain noxious gases renders their presence in the air, as well as that of organic matter, harmful to those who sleep upon or near the ground.

In the tropics especially, in addition to a proper sewage system, a sanitary abode seems to require good drainage, elevation, with the ground under and immediately around the house surfaced with concrete or other impervious material, tight floors, and thorough ventilation. The prevailing absence in the Philippines of these sanitary conditions is an important etiological factor of disease, closely allied to medical climatology, and is entitled to careful consideration in any discussion of climate in its relation to health.

As the surroundings of a dwelling should lend much to health and comfort, the ground should slope away from the house, carrying all surface water to a distance, and the intense light of the dry season be softened by the presence of lawns and shrubbery around the dwelling. A pleasing landscape with the soothing influence of its predominating color of green appears to have been regarded as of very little importance in Manila. It is unfortunate that in these islands, where the benefits of plant life are so easily obtainable with a minimum of effort, there are not more habitations surrounded by lawns and flower gardens.

Medical climatology also involves the matter of a pure and abundant water supply, which is an important factor in the healthfulness of any locality. Because of the pathogenic organisms which water frequently contains, many refrain from drinking a sufficient amount of wholesome water and incline to the excessive use of alcoholics. Hydrotherapy in the tropics seems to be particularly appropriate. It appears to be the consensus of opinion among medical men that, as a rule, the *quantity* of pure, wholesome water is of more value than the medicinal virtues of the water of this or that mineral spring. The frequent excessive use of alcoholics and the tendency to abstain from drinking water on account of the danger of contracting disease thereby has claimed the attention of investigators.

Wulffert, of Berlin, describes the effect of alcohol in the tropics upon the digestive organs, nervous system, and the heart, and comes to the conclusion that these organs are hampered by its use in their effort at adaptation to the hot climate, regulation of bodily heat being disturbed, excessive perspiration induced, and the organs weakened as to power of overcoming disease. Similar conclusions

are reached by other physicians, among them being Fiebig, Rudel, Anschutz, Schwalbe, and Breitenstein. Fiebig states that of 40 cases of "black-water fever" which he treated in the tropics, all were alcoholics. From his investigations, Wulfert concludes that the obstacles which oppose acclimation are those which are presented by local conditions; example, malaria, and those which lie in the colonizer himself; example, the alcohol habit, and that "a white people addicted to the alcohol habit can never hope to settle tropical countries," and recommends as preparatory measures for life in the tropics:

"1. Vigorous bodily work or sport in the open.

"2. The use of the system of diet recommended for the tropics by Rubner, a system which he considers as not unsuitable also to the temperate zone.

"3. Complete abstinence from intoxicating liquors."

Referring to the prevalence of alcoholism, Munson states: "In the military service the abuse of alcoholic liquors is one of the most potent factors by which efficiency is impaired, and in the past its effects were so apparent that drunkenness was largely looked upon as a distinctively military failing. Its influence as well as its prevalence is indifferently shown by military statistics; for all drinking men do not enter hospitals for alcoholism, and a certain proportion of drunkards succumb to such various diseases as gastritis, cirrhosis of the liver, and nephritis, in the development and ultimate result of which the use of intoxicants has probably played no minor part; further, the term alcoholism includes many pathological conditions and their symptoms, these varying according to the quantity of alcohol taken and the manner in which it is consumed."

In a climate like that of the Philippines there is little excuse for being deprived of an abundance of air in-doors, or for overcrowding and little ventilation. The conditions are favorable to living practically in the open air night and day.

Even in the time of Hippocrates the stated laws of health recognized a proper relation between food and drink and exercise, expressed by the formula, "temperance and exercise."

The climate of the Philippines is favorable, in that exercise can be taken practically in the open air at all times of the year, where properly constructed and healthful habitations are available. Abnormal physiological function in the tropics is believed to be due largely to the lack of physical exercise.

Parkes estimates that "every healthy man ought to take daily an amount of exercise equivalent to 150 tons lifted one foot, or a walk of about nine miles," which is practically equivalent to the average demands of a majority of trades and manual occupations.

In addition to shelter and surroundings, the influence of climate is further modified by the appropriate use of food and clothing.

Climatic conditions appear to be more favorable in the Philippines than in the temperate zone for the observance of the hygiene of clothing.

Notwithstanding the climate of the Philippines is commonly referred to as enervating, Americans connected with the public service, whether engaged upon work in offices or upon work requiring their presence in the open air, have probably on the average accomplished more in the islands than is ordinarily accomplished at home in similar lines of work. Regular habits, the leading of a temperate life, and the absence of indulgence in excesses, have much to do with one's health in any country. The climate of these islands should not be held responsible for illness or physical breakdown due to those excesses which tend to physical demoralization in the temperate zone. Absence from home environment and restraints probably accounts for a large number of Americans who, by plunging into excesses of various kinds, caused their own physical demoralization and failure.

It should be remembered that there is no place, even in the temperate zone, suitable for and agreeable to all persons. There are so great a variety and so many degrees of physical obliquity that no single combination of climatic influence, however favorable, can be found to meet all conditions. Because the climate of the Philippine Islands does not agree with some, even who take reasonable care of themselves, does not necessarily indicate that the climate is unhealthful. The physical condition of many improves after coming to the islands, and that of others remains normal.

As a general rule, the appearance of Europeans living in the tropics seems to indicate an anæmic condition. The "cry of the system for better blood," expressed in the form of neuralgia, is, however, rare. In this connection Cabot states: "The most striking example of the fallacy of judging of anæmia by the color of the skin and mucous membranes is the so-called 'tropical anæmia.' Practically all persons belonging to white races who take up their abode in the tropics acquire, after a term of years, an extreme pallor of the skin and mucous membranes, and this appearance has usually received the title of 'tropical anæmia.' It turns out, however, from the careful studies of several different investigators, that the blood of such persons shows absolutely no anæmia or other variation from the normal. The appearance of the skin is probably due to the action on the peripheral nerves and vessels. Tropical anæmia is a condition not of the blood, but of the skin and subcutaneous tissues." These views are confirmed by the more recent studies of Phlen, Marestang, Gringus, and Eijkmann. Gottstein concludes that "as a result of long residence in the tropics neither a quantitative change of the blood nor a reduction in the number of its cells or its hæmoglobin-content takes place." These conclusions are verified

by the following results of examinations recently made by Mr. M. T. Clegg, under the direction of the Acting Superintendent of Government Laboratories, of twenty-three employes of the Philippine Civil Service, selected at random, who have been continuously in the Philippine Islands for over four years:

Age.	General health.	Contin- uous resi- dence (years).	Weight on arrival.	Weight at present	No. of red blood cor- puscles per cent. c.m.	Specific gravity of blood.	Hæmo- globin esti- mate per ct.	Color index
27	Feeling of debility during past three months	4¾	128	152	5,000,000	1060	100	1
32	Has feeling of debility at times	6	140	150	5,000,000	1060	100	1
33	Good	5½	155	150	4,800,000	1060	100	1
28	Has had typhoid fever and dysentery	6½	160	210	5,000,000	1060	100	1
33	Has had dengue	6	157	197	5,000,000	1060	100	1
34	Has had dysentery . . .	6	158	123	4,000,000	1056	80	1
30	Has had typhoid	5½	137	135	5,000,000	1060	100	1
30	Malarial fever (1900) . .	5½	170	175	4,500,000	1056	80	0.9
30	Good	5½	160	172	4,800,000	1059	95	1
32	Good	6	180	160	5,000,000	1060	100	1
25	Good	6	160	150	4,500,000	1059	95	1
28	Fair	6½	132	134	4,500,000	1056	80	0.9
34	Good	5½	148	148	4,800,000	1059	95	1
30	Good	5¼	156	148	4,500,000	1059	95	1
34	Good	6	126	142	4,800,000	1059	95	1
33	Good	6	178	164	5,000,000	1060	100	1
33	Good	4½	170	182	5,000,000	1060	100	1
28	Good	6	140	135	4,800,000	1059	95	1
33	Good	6	145	154	4,500,000	1057	85	0.95
31	Good	6½	155	155	4,800,000	1059	95	1
...	Eight days with cholera	4½	157	186	5,000,000	1060	100	1
...	Good	6¾	120	145	5,000,000	1060	100	1
28	Good	6½	185	156	4,800,000	1059	95	1
30.9	Average	5.8	152.9	157.5	4,786,956	1059	95	

NOTE.—Hammerschlag's method was used in estimating specific gravity and hæmoglobin.

Cantlie observes that about two years are required for acclimation of the white man in the tropics, after which good health is a reasonable expectation. Calvert makes a similar observation. These views seem to be borne out by statistics of the Board of Health of the Philippines,¹ which show the general average of sick days per year for five years for each American employé connected with the Civil Service of the Philippine Government as follows: First year, 4.80; second year, 7.63; third year, 4.47; fourth year, 0.81; fifth year, 0.03. Further corroboration is found in the following reported by Marston, showing the death rate of British white troops in India per thousand, based upon statistics for a period of eight years prior to and including 1884: First and second years of service, 6; third to sixth years of service, inclusive, 1.88; seventh to tenth years of service, inclusive, 0.73.

¹ Results of a Preliminary Study of the Health of Americans in Manila.

The period of foreign service of the United States Army being two or three years, appears to cover practically the usual period of acclimation. The conclusion appears to be reasonable that the fourth and fifth years of residence in the Philippines are more agreeable from the standpoint of health than any of the preceding years, as is indicated by the Board of Health statistics, a large proportion of the personnel of the Philippine Civil Service having been recruited from officers and enlisted men of the volunteer establishment of the army. The views expressed by the president of this Medical Association, Dr. McDill, in his annual address, are in accord with conclusions reached by other observers.

The influence of the climate of the Philippines from a surgical point of view is clearly expressed by Major J. M. Banister, of the Medical Corps of the Army, in the following propositions:

"1. Aseptic results will just as surely follow aseptic methods in the Philippines as in the United States or Europe.

"2. Should septic infection occur in any clean case subjected to operation in the Philippines, blame the technique, not the climate.

"3. Successful attainment of the object for which the operation has been undertaken will follow careful and skilful surgery in the Philippines with the same regularity that we have been accustomed to observe in such work at home.

"4. Convalescence after surgical operations in the Philippines is rapid and satisfactory when such operations have been carefully and skilfully performed.

"5. The danger of mortality after a skilfully performed surgical operation in which all the details of a rigid aseptic technique have been carried out is not increased by the influences of the climate of the Philippines unless the patient is at the same time the victim of some other serious disease."

Similar views are expressed by the Attending Physician and Surgeon, Civil Hospital, in his report submitted in 1903 to the Secretary of the Interior.

Major-General Wood, Governor of the Moro Province, in his annual report to the Governor-General, states: "There is nothing in the climate of this portion of the island which prohibits a long residence here. The British residents of North Borneo and the Malay Peninsula and the Dutch in Java manage to live apparently very contented and healthy lives in those countries, which are hotter than any portion of the Philippine Islands. While the service is in a way severe, it does not seem to deter the average Englishman or Dutchman from competing eagerly for positions in the government of the colonies, and it is believed that Americans can live and do good work where any other white race can. A moral life, with plenty of hard work, will be found to counteract in most cases the so-called demoralizing effects of the Philippine climate."

The revelations of bacteriological research of the last few years, arming men with a knowledge of the causative factors of many tropical diseases, have diminished the importance of their geographical and meteorological relations, have destroyed theories of the climatic origin of disease, and thereby robbed the tropical climate of many of its terrors, such as yellow fever, malaria, Asiatic cholera, and dysentery. Among Americans the late lamented Major Walter Reed and his coadjutors did monumental work along this line in Cuba and the Army Laboratory at Washington. The preliminary work of the bacteriologists and pathologists connected with this magnificent and splendidly equipped new laboratory¹ in the Far East gives every indication that the research work already inaugurated will show brilliant results and add new names to the long list of investigators whose work and discoveries in the field of preventive medicine deserve the gratitude of the whole world.

CONCLUSIONS. 1. With respect to the principal climatological factors, temperature, humidity, and atmospheric movements, the climate of the Philippine Archipelago is not extreme, as it is distinctly insular in character, the greater portion of the land area being not far distant from the ocean. There are other modifying influences which obtain in portions of the archipelago, such as general oceanic and local interisland currents, prevailing winds, elevation, the state of cultivation and drainage of the soil, and the presence of forests and other plant life.

2. Excluding localities in the tropics characterized by excessive heat, high relative humidity, or unhealthful soil conditions, acclimation or physiological adaptation of the white man to tropical environment is possible.

3. If acclimation is possible, colonization is possible.

4. Failures of the white race to live in the tropics and maintain health, excluding localities indicated in the second conclusion, appear to have been due principally to non-observance of the rules of personal, domestic, and public hygiene.

5. As a rule, Americans appear to become acclimated in the Philippines during the third year of residence.

6. With sanitary surroundings and by observing the rules of personal and domestic hygiene, residence of Americans in the Philippine Islands appears to be attended with as little danger of disease and death as residence in the United States under similar sanitary conditions.

¹ The second annual meeting of the Philippine Islands Medical Association was held in the new Laboratory Building of the Bureau of Government Laboratories in Manila.

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